DOCUMENT RESUME

ED 332 874 SE 052 121

AUTHOR Brickle, Woodrow, II
TITLE Improving the Problem Solving Skills of At-Risk High School Mathematics Students through Cooperative Work Groups and Computer-Assisted Instruction.
PUB DATE Dec 90
NOTE 76p.; Ed.D. Practicum Report, Nova University.
PUB TYPE Dissertations/Theses - Practicum Papers (043) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Achievement Gains; Compensatory Education; *Computer Assisted Instruction; *Cooperative Learning; Dropout Characteristics; Dropout Prevention; Educationally Disadvantaged; *High Risk Students; High Schools; Learning Activities; Learning Strategies; Manipulative Materials; Mathematics Achievement; Mathematics Education; *Mathematics Instruction; *Potential Dropouts; Practicums; Problem Solving; *Secondary School Mathematics; Special Needs Students

ABSTRACT

The negative impact of low attendance and the lack of effective, alternative classroom learning strategies are factors that mitigate against student interest and success in mathematics, particularly with respect to inner-city at-risk students. The goal of this practicum was to improve the problem-solving skills of a group of 50 alternative high school students by strengthening these students' appreciation of and interest in mathematics, by increasing students' schedule of attendance in scheduled mathematics classes, and by improving students' performance on the school's standardized basic skills test in mathematics. For a period of three months, computers, manipulatives, cooperative groups, and Socratic questioning in the mathematics classroom were used to address a variety of learning preferences. No measurable differences could be noted from the pre- and post-test interest survey responses. However, improved student performance and documented increases in class attendance suggest that the design of mathematics instruction to accommodate differences in students' learning preferences is an effective strategy for addressing the unique needs of the at-risk alternative high school student. The report includes 28 references and the student and teacher questionnaires. (JJK)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED332874

Improving The Problem Solving Skills of At-Risk High School Mathematics Students Through Cooperative Work Groups and Computer-Assisted Instruction

by

Woodrow Brickle II

Cluster XXXIV

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Woodrow Brickle II

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

A Practicum I Report Presented to the Ed.D. Program in Child and Youth Studies in Partial Fulfillment of the Requirements for the Degree of Doctor of Education

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it

☐ Minor changes have been made to improve reproduction quality

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

NOVA UNIVERSITY

1990

BEST COPY AVAILABLE

SE 052 121

PRACTICUM APPROVAL SHEET

This practicum took place as described.

Verifier: Martin L. Stuckey
Martin Stuckey

Project Director
Title

Atlanta, Georgia
Address

December 10, 1990
Date

This practicum report was submitted by Woodrow Brickle II under the direction of the advisor listed below. It was submitted to the Ed. D. Program in Child and Youth Studies and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova University.

APPROVED:

April 4, 1991
Date of Final Approval of Report

Mary Ellen Sapp
Mary Ellen Sapp, Ph. D.,
Advisor

ACKNOWLEDGEMENTS

The following individuals are acknowledged for their support, encouragement, and assistance in the development and implementation of this school improvement project.

Anne, the family, and Mary whose loving and unselfish personal and professional sacrifices have made this effort possible;

Martin Stuckey, under whose professional leadership and at whose academic work setting this project was developed and implemented;

Roosevelt Howard, who willingly contributed both his expertise in the use of computer technology and his wealth of computer software to this effort;

Mary Ellen Sapp, under whose professional guidance and advisement this activity was undertaken;

Jackie and Michelle, whose expertise in typing and APA formatting has been invaluable;

Annie Lee Brickle, the most loving, understanding, and encouraging mom on the face of this beautiful earth;

and

Jehovah God, the source of life and superlative wisdom, the one who supplied these gifts that this effort might be possible.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS.....iii

TABLE OF CONTENTS.....iv

LIST OF TABLES.....v

LIST OF FIGURES.....v

ABSTRACT.....vi

Chapter

I. INTRODUCTION.....1

Description of Work Setting and Community.....1
Writer's Work Setting and Role.....4

II. STUDY OF THE PROBLEM.....5

Problem Description.....5
Problem Documentation.....6
Causative Analysis.....10
Relationship of the Problem to the Literature....12

III. ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS....20

Goals and Expectations.....20
Behavioral Objectives.....21
Measurement of Objectives.....22

IV. SOLUTION STRATEGY.....23

Discussion/Evaluation of Possible Solutions.....23
Description of Solution Selected.....31
Report of Action Taken.....34

V. RESULTS, DISCUSSION AND RECOMMENDATIONS.....41

Results.....41
Discussion.....50
Recommendations.....53
Dissemination.....54

REFERENCES.....55

Appendices Page

A STUDENT QUESTIONNAIRE.....59

B TEACHER QUESTIONNAIRE.....61

C STUDENT MATH INTEREST SURVEY.....63

D SOUTHERN BELL GRANT PROPOSAL RESPONSE.....67

E APPLE CORPS GRANT PROPOSAL RESPONSE.....69

LIST OF TABLES

Table

1 Student Placement.....4

2 BST Practice Test Profile Summary.....7

3 Commprehensive BST Practice Test Profile-A.....8

4 Forty-day Pre-Practicum Attendance Data.....10

5 Student Home Supervision.....11

6 Comprehensive BST Practice Test Profile-B.....43

7 Sixty-day Practicum Attendance Data.....47

LIST OF FIGURES

Figure

1 Pre- and Post-Test Math Performance Comparison....44

2 Initial and Terminal Attendance Data Comparison...48

ABSTRACT

Improving The Problem Solving Skills of At-Risk High School Mathematics Students Through Cooperative Work Groups and Computer-Assisted Instruction. Brickle II, Woodrow, 1990. Practicum I Report, Nova University, ED.D. Program in Child and Youth Studies. Descriptors: At-Risk Student/ Alternative Education/CAI/Cooperative Learning/Cooperative Work Groups/Dropout/Learning Modalities/Learning Preferences /Learning Styles/Manipulatives/Math Achievement/Math Instruction/Mathematics Problem Solving/Peer Coaching/ Problem Solving

The goal of this practicum was to improve the problem-solving skills of a group of high-school alternative education students as evidenced by improved performance by these students on the problem-solving indicator clusters of the school's standardized basic skills test in mathematics. Three broad objectives designed to achieve this goal were: (1) to increase or heighten the students' appreciation of and interest in mathematics; (2) to increase the students' attendance in scheduled mathematics classes; and (3) to improve the students' performance on the five problem-solving indicator clusters of the school's standardized basic skills test in mathematics.

Computers and cooperative problem-solving strategies were employed ir the classroom during a three month period to achieve the practicum objectives. Manipulatives, calculators, simulations and positive reinforcement were used to add variety, promote interest and address multiple learning modalities. Initial and appropriate terminal assessments were made of students' learning preferences, problem-solving ability, class attendance and math interest.

The overall practicum outcome was positive. Achievement of the first objective, however, could not be verified by the practicum results. No measurable differences or improvements could be noted from the pre- and post-test interest survey responses. It is thought that the practicum implementation period of three months may not have provided sufficient time to have measurably impacted such deeply ingrained factors as attitude and interest. The remaining two objectives, on the other hand, were successfully achieved. The improved academic performance by students and the documented increases in class attendance make a strong composite case for the use of computer-assisted instruction and cooperative learning to enhance the problem-solving skills of at-risk alternative high school students. The positive outcomes also suggest that the design of educational instruction to accommodate differences in students' learning preferences is warranted in the continuing quest by educators for effective strategies in addressing the unique needs of the at-risk alternative high school student.

CHAPTER I

INTRODUCTION

Description of Work Setting and Community

The setting in which this practicum was performed is an alternative senior high school in a large urban area. The school is one of six alternative programs serving predominantly minority students who were administratively placed or who voluntarily enrolled.

The school is a joint venture academic setting sponsored by a private corporation in conjunction with the local public school system and other federal agencies. The program was initiated twenty years ago to give students in need of a second chance an opportunity to attend school and to continue their education. This is the third year of operation for the program at this work site.

Initially, the school vision centered on assisting youth who had dropped out of school in an effort to attract students back into the world of education. The unique feature that made the program work was the recruitment of staff who assisted youth in solving the non-educational problems they were facing, such as care for their children, health needs, food shortages, legal assistance, housing requirements and jobs.

Now, the program is to help the population at greatest risk, urban teenagers, in bringing the social service resources of the city into the school. The goal is to meet student needs by combining public education with the world of social services. The reasoning is that if schools and agencies coordinate their efforts, and if a greater commitment to personalism in all programming can be made, then better educational results with youth will certainly follow.

Each of the six schools operates under the management of a director or principal. However, all six programs under sponsorship are managed by a city director who has the responsibility of administering the overall program.

The ninth through twelfth grade students served at the writer's location fit the typical description given by Mann (1986) of classic at-risk students whose attendance, conduct, academic achievement and interest in school are all below acceptable levels.

With a parent or guardian as witness, each student signs a contract to attend school regularly and to avoid disruptive behaviors. These students are expected to reach the same mastery in mathematics as students in the traditional school setting; they must pass a state minimum skills test, Basic Skills Test (BST), to receive a high school diploma.

The results of a student population survey (Appendix A) developed by the writer and administered to the 53 students initially enrolled at the school (50 were enrolled in mathematics) indicating the reasons for student placement in this setting are summarized in Table 1 from which the following can be seen:

A. On the ninth grade level, two students were admitted because of poor attendance; three students were admitted because of unresolved discipline problems; one student was referred by the administration; and one student requested attendance by completing an application to the school.

B. Six tenth graders were admitted because of poor attendance; four were admitted because of discipline problems; five were admitted because of administrative referral; and three tenth graders requested to be admitted.

C. Four eleventh graders were admitted because of attendance problems; six were admitted because of discipline problems that were unresolved; four were admitted because of administrative referral; and three eleventh graders were accepted upon student and parent request.

D. Two twelfth graders were admitted because of irregular attendance in a traditional school; five were admitted because of unresolved discipline problems; three were admitted upon referral by an administrator and one senior requested placement at the school.

Table 1

Student Placement

Reason for student placement	Grade 9	10	11	12	Student total
Attendance	2	6	4	2	14
Discipline	3	4	6	5	18
Referral	1	5	4	3	13
Other (choice)	1	3	3	1	8
Total number of students	7	18	17	11	53

Writer's Work Setting and Role

The writer is a twenty year mathematics teacher in the city school system; placement has recently been made to this alternative school setting. The writer's teaching responsibilities include the instruction of developmental and remedial mathematics courses in preparation for student mastery of math cluster skills included on the state mandated basic skills examination (BST) required for a high school diploma.

Fifty students were initially scheduled for daily mathematics classes. The writer was the primary mentor, counselor, and the sole mathematics instructor for the fifty school enrollees.

Chapter II

STUDY OF THE PROBLEM

Problem Description

The problem addressed in this practicum was the unacceptably low attendance and performance in mathematics demonstrated by class attendance reports and results on the school's standardized Basic Skills Practice Test (BST) by the fifty students initially enrolled in mathematics classes in the writer's school setting.

School records examined by the writer for these students documented the fact that all enrolled students in this setting had experienced or were experiencing personal or social problems that negatively impacted their self-esteem, school attendance, academic skills, and attitudes about school and about learning.

Of particular concern to the writer in the area of academic achievement was the lack of mastery evidenced by the students on the five problem-solving indicator clusters, clusters 10-14, on the math section of the school's standardized BST Practice Test, during the 1989-90 spring administration of this instrument.

Problem Documentation

The five problem-solving indicators of the BST Practice Test that were of primary focus in this practicum and that were extracted directly from the state's skill descriptors (1986, pp. 5-6) are indicated below:

MATHEMATICS INDICATORS: PROBLEM SOLVING SKILLS

This skill area requires the student to select and apply the appropriate concepts and/or operations to solve problems.

Indicator 10:	The student estimates results using rounded numbers, with or without units of measurement, in the context of academic tasks, everyday tasks, or employment activities.
Indicator 11:	The student selects appropriate operations for a given problem situation in the context of academic tasks, everyday tasks, or employment activities.
Indicator 12:	The student solves simple word problems in the context of academic tasks, everyday tasks, or employment activities.
Indicator 13:	The student organizes data into tables, charts, and graphs in the context of academic tasks, everyday tasks, or employment activities.
Indicator 14:	The student interprets data which has been organized in the context of academic tasks, everyday tasks, or employment activities.

Table 2 summarizes the performance of the enrolled students on the five problem-solving clusters of the test administered to students during the spring of the 1989-90

school year. Of the fifty students tested on the BST practice test, less than 12 students passed indicator 10 and 11 with 70 percent mastery; only 19 passed indicator 12 and 13; and only 18 passed indicator 14 on the test. The large number of students failing the practice test indicates that a problem exists and there is need to increase performance on problem solving indicators of the state mandated BST.

Table 2

Basic Skills Test Practice Test Profile

Spring 1990

	BST Problem solving math indicator clusters				
	10	11	12	13	14
Number of students passing	11	10	19	19	18
Number of students failing	39	40	31	31	32

This summary was compiled from Table 3 which provides the complete data set for the performance of all students on each of the five clusters. Seventy percent minimum mastery is indicated with a plus sign, non-mastery with a minus.

Table 3

Comprehensive Basic Skills Practice Test Profile-A

Problem Solving

Student	BST indicators				
	10	11	12	13	14
A	+	-	+	-	-
B	-	-	+	+	+
C	-	-	+	+	+
D	-	-	-	-	-
E	-	-	-	-	-
F	-	-	+	+	+
G	+	+	+	-	-
H	+	+	+	-	+
I	-	-	-	-	-
J	+	-	+	+	-
K	-	-	+	-	+
L	-	+	+	+	-
M	-	-	-	-	-
N	+	-	-	-	+
O	-	-	-	+	-
P	-	-	+	+	+
Q	-	-	+	-	-
R	-	-	-	-	-
S	-	-	+	+	+
T	+	-	+	+	+
U	-	+	-	+	+
V	-	-	-	-	-
W	-	+	-	+	+
X	-	-	-	-	-
Y	-	-	-	-	-
Z	-	-	-	-	-
A-1	+	+	+	+	-
B-1	-	-	-	-	-
C-1	-	+	+	+	+
D-1	+	-	-	-	+
E-1	-	-	-	-	-
F-1	-	-	-	-	-
G-1	-	-	-	-	-
H-1	-	-	-	-	-
I-1	-	-	-	-	-
J-1	-	+	-	+	-
K-1	-	+	+	+	+
L-1	-	-	-	-	-
M-1	-	-	-	-	-
N-1	+	-	-	+	-
O-1	-	-	+	+	+
P-1	-	-	+	-	+
Q-1	+	-	-	+	+
R-1	-	-	-	+	+
S-1	-	-	-	-	-
T-1	-	-	-	-	-
U-1	-	-	-	-	-
V-1	-	-	-	-	-
W-1	+	+	+	-	-
X-1	-	-	-	-	-
Total passing (>=70%)	11	10	19	19	18
Total failing (<70%)	39	40	31	31	32

As can be seen from the data in Table 3, approximately 18 of the 50 students were already demonstrating 70 percent mastery on three of the five problem solving clusters while approximately 32 were deficient in this expectation.

Furthermore, students enrolled at the school had poor attendance. Many of these students could have attended school regularly but did not. Table 4 gives specific attendance data on students taught by the writer during a two-month period.

Analysis of attendance data appearing in Table 4 indicates that the overall average daily attendance (ADA) for the period is 50 percent. In a two month period, the students enrolled in first period mathematics experienced 54 percent ADA; the third period experienced 59 percent; fourth period 55 percent; fifth period 40 percent; and the sixth period experienced 44 percent ADA.

Absenteeism was consistently over 40 percent, in some classes nearly 60 percent. Absenteeism above a margin of 30 percent is unacceptable and in need of correction. The negative impact upon academic achievement is obvious.

Table 4

Forty-Day Pre-Practicum Attendance Data

Class period	Number of students on roll	Days for perfect attend-ance	Absences for the period	Percent absent	Percent (ADA)
1st	12	480	223	46	54
2nd	-	-	-	-	-
3rd	10	400	163	41	59
4th	8	320	142	45	55
5th	12	480	288	60	40
6th	8	320	179	56	44
Total	50	2000	995	50	50

Causative Analysis

Examination by the writer of students' academic and personal school files indicated numerous contributing factors to low student performance and poor attendance. These records documented a history of unresolved personal or social problems on the part of students which could negatively impact student self-esteem, school attendance, academic skills and student attitudes about school and learning. Many of these problems were home and

environmental in nature; some involved drug use and inadequate home supervision.

Though these inner city students arrived at school from a variety of home environments (housing projects, single parent homes, middle class homes and two parent homes), only seven of the 53 receive regular supervision from two parents. All others are in households headed by single working parents.

Table 5 summarizes the student survey data of Appendix A indicating the home supervision for enrollees at this school. From the table it can be seen that of the 53 students initially enrolled, seven lived in a two parent home; 29 lived with a single parent, mother; 11 lived with a single parent, father; four lived with a grandmother who was the only parent in the home; and two lived with an aunt who had legal guardianship. The majority of the students, 29, lived with a single mother who worked and/or received public assistance.

Table 5

Student Home Supervision

	Two parents	Single parent		Guardian	
	Mother & father	Mother	Father	(G)Mother	Aunt
Number of students	7	29	11	4	2

The problem as it related more specifically to low math achievement seems to have been rooted in the fact that in addition to high student absenteeism, the variety of approaches, methods, and media available to effectively meet the diversity of student needs and learning styles was not being systematically and consistently utilized.

Examination of lesson plans used previously for mathematics showed that group or cooperative learning strategies were not regularly used by the teacher to enhance interest. The teacher was more likely to follow the familiar traditional methods of instruction rather than explore and employ available materials and technology for enhancing classroom learning.

Finally, there was inadequate use of technology in the teaching process; computer-assisted methods which could be used to vary and individualize instruction was rarely used for aiding students in the application of mathematical concepts and relations to the solution of routine and non-routine problems. A clearly defined use of technology and non-traditional innovations in math education was not yet evident in this setting.

Relationship of Problem To Literature

Some of the underlying causes of this problem of low interest and achievement in math problem solving as well as the high rate of student absenteeism experienced in this setting are documented in the literature.

Will (1989) maintains that instructional approaches which are successful with the average student do not always work with the student with special learning problems or the at-risk student. Successful approaches with these students must emphasize productive learning experiences. Among such experiences is that of "personalized curricula" (p.7) geared to individual learning needs and styles in which computer technology is an asset.

Steen (1989) identifies several factors which impede the development of math problem solving ability but which can be effectively addressed in the classroom. According to Steen students must be guided away from voluminous drill and practice and must be helped to solve problems in a wide variety of contexts. They must learn to reword and restructure unclear problems to a form more suitable for analysis at their own levels; they must learn to select appropriate strategies and operations for solving problems; they must learn to recognize and develop multiple solutions to some problems and discern when no solution exists for others; and they must learn to work with others in achieving mutually agreeable solutions to problems shared commonly by many.

Willoughby (1989) contends that the new standards for mathematics suggesting that all students can and should study algebra, geometry, statistics, probability, and other topics can be addressed with the selection of materials that cover various aspects of mathematics in a logical, fun

manner. Software, workbooks, and textbooks being published provide a variety of materials for teachers to utilize in the mathematics classroom. He further suggests that citizens of the next millennium will have calculators, computers, and other technology to do the symbol pushing for them. However, they will have to decide which symbols need pushing and what meaning symbols have after the machines are finished pushing them.

This implies that people will have to recognize all sorts of mathematical situations when they read about them, hear about them, and experience them. They must also learn to understand when a situation can be better solved by using mathematics and when it cannot. They must learn to formulate a problem in mathematical terms and how to go about solving it. Most importantly, reports Willoughby, they must learn to communicate with others about their solutions.

Schoenfeld (1989) purports that mastery of procedures is important, but it is also sterile. A problem for a mathematical student is a task (a) in which the student is interested and engaged and for which he wishes to obtain a resolution, and (b) for which the student does not have a readily accessible mathematical means by which to achieve that resolution. Learning results from explicit instruction that focuses on metacognitive aspects of mathematical thinking; instruction takes the form of "coaching" (p.97). This "Self-regulation" (p. 94) learning is when a person

understands his/her own thought processes. Agreement is given to Mason, Burton and Stacey (1982) and the summation that instructional environments in which students come to see mathematics sense-making as something natural is desired. It is strongly believed that these environments must be the norm rather than the exception.

Vincent and Bostdorff (1990) regarded poor attendance as a major contributor to student failure and implemented a program to increase student attendance that had positive results. In a Crestline, Ohio high school, students were grouped into two categories: those students who missed an excessive number of days each school year, usually 25; and those who had generally good, but not perfect attendance. The project coordinators decided that the first group would be unaffected by a reward policy. The attendance of these students was affected by other complications, such as social and family strife, juvenile delinquency, and emotional problems. The traditional methods of discipline, social services, and the court system seemed to be the correct methods to deal with these students. The Crestline Reward Policy was written to target those students identified in the latter group. These student missed a few days of school each year for such reasons as family trips, health-related appointments, or just for an occasional day off. The Reward Policy stated that: "Any student who has perfect or near-perfect attendance during a semester will be allowed to waive one of his/her midterm or final exams. If a student

has perfect or near-perfect attendance throughout the year, he/she may waive one midterm exam and two final exams" (p. 94). Near perfect was defined as no more than 1/2 day absence and no more than two tardies a semester. Summatively, the writers concluded that the teacher frequently holds the key to school attendance; it is the teacher who is the role model for pupils. After the first year of implementation, the attendance jumped from 93.7 percent to 94.5 percent. In two school years the attendance rate increased from 91.6 percent to 96 percent. These figures continued to rise during the third year of implementation. Nothing was done to change the attendance routine at the school other than implementation of the reward policy.

Moreover, Alderman (1990) reports that student motivation for learning can be addressed by the motivation theory of attribution which can help teachers to understand students who have a pattern for failure. The reasons assigned for achieving success or failure are called attributions. The most common attributions used are: not having the ability; not expending enough effort; task difficulty; and luck or guessing. These attributions are further categorized into two dimensions-stable-unstable and internal-external. Stable-unstable refers to the consistency of a student's pattern of failure. Internal-external refers to the student's beliefs that the cause of failure lies either within or outside the student. Alderman

believes that teachers who are successful in reaching low-achieving students combine a high sense of their own efficacy with high, realistic expectations for student achievement. Teacher efficacy refers to teachers' confidence in their ability to influence student learning and motivation. Teachers with a high sense of efficacy are more likely to view low-achieving students as reachable, teachable, and worthy of their attention and effort. Additionally, there must be links between what the student did and the outcome. The Alderman developed "links" (p. 28) for helping the helpless student become successful and in turn develop an increased sense of self-worth are: link one-proximal goals, students setting goals for performance that provide a mechanism for self-assessment; link two-learning strategies, students identify the learning strategies that would be beneficial; link three-successful experience, students measure their own success using the proximal goal; and link four-attribution for success, students attribute success to their personal effort or abilities. The role of the teacher is questioning and probing the student in link four to help the student to identify what was done to attain the results. The teacher must model and give feedback in link four about why the student succeeded or failed at the task. Teachers should be cautious in assigning lack of effort as the cause of

failure; they should use this attribution only when they are sure the task was within the student's capability. Optimum student motivation in this links model is achieved only when classroom structure supports student goals, effort, and the use of effective strategies. Teachers in mastery classrooms of this nature give students opportunities to relearn concepts and correct errors. Low-achieving students in particular need to know exactly what they are expected to do and the criterion for measuring their success. No claim is made that the links will work miracles with at-risk students but according to Alderman, "the links provide teachers and students with a framework for beginning the cycle of progress that fosters self-responsibility for learning" (p. 29).

Perrin (1990) reports that at the Amityville High School in New York, students participated in a learning styles project for potential dropouts. These students had experienced failure in two or three subjects, scores in the fifth stanine or below on a standardized reading test, and excess absences. The teachers were trained during the summer in the Dunn and Dunn (1978) model of learning styles. At the beginning of the school year, students were block scheduled to group the students together for tenth grade math, social studies, English, reading and science during the regular school day. After the introduction of the learning styles concept to students, personal study habits

and different environments for learning were discussed. Students received individual printouts indicating their learning strengths and weaknesses; conferences with each student were held on how to interpret the results. Teachers met regularly-weekly to consult with each other to plan instructional strategies for students working alone, in small groups, or with the teacher; To develop activities suited to the various perceptual strengths of students; and to design ways to accommodate their environmental and physical needs. Gradually, students began to recognize and respect their individual differences and to experience success in the form of passing grades. By the end of the second quarter, all but one of the students chose to remain in the program. And at the end of the tenth grade, every student passed his or her English, social studies, math, and science courses. Their grade point averages (GPAs) reflected mean increases of 18 points in English, 8 in social studies, 4 in math, and 10 in science over their ninth grade GPAs. Furthermore, the gains in self-esteem were immeasurable. The students became confident and accepted responsibility for their learning.

The literature repeated points up the undesirable impact of low attendance and the lack of effective motivational strategies with at-risk students upon achievement. A common thread seems to be woven throughout the research indicating that these factors mitigate against student interest and success in both school and learning.

Chapter III

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Goals and Expectations

The goal of the practicum was to increase student mastery of the mathematics problem-solving skills indicated on the State-wide minimum standard Basic Skills Test for the acquisition of a high school diploma.

While it would have been desirable to project that all fifty students would achieve 70 percent minimum mastery on each of the five skill clusters for problem solving, the more realistic expectation of this writer in consultation with the program director was that instruction during the teaching period should produce 70 percent minimum mastery on three of the five problem solving clusters by at least 38 of the 50 students or at least 70 percent of the enrollment in mathematics. Since 18 of the 50 students were already demonstrating the math expectation, the goal was to assist at least 20 of the 32 students deficient in this expectation to achieve 70 percent minimum mastery on at least three of the five math problem solving indicators on the fall/winter administration of the school's standardized Basic Skills Practice Test. In addition, student attendance was projected to increase by a minimum of 20 percentage points to bring overall class attendance to at least 70 percent

minimum ADA.

Approaches and methods used in the mathematics classroom were expected to achieve the primary goal of increasing student interest in and mastery of mathematics. Improved attendance in math classes was anticipated as an equally important outcome of effective practicum implementation.

Behavioral Objectives

Upon completion of the twelve week implementation period for this practicum, 20 of the 32 targeted students from the 50 enrollees in mathematics were projected to demonstration 70 percent minimum mastery on at least three of the five problem solving indicator clusters on the school's 1990-91 fall/winter administration of the Basic Skills Practice Test (BST) as summarized below:

Cluster 10:	Estimates results using rounded numbers, with or without units of measurement, in the context of academic tasks, everyday tasks, or employment activities.
Cluster 11:	Selects appropriate operations for a given problem situation in the context of academic tasks, everyday tasks, or employment activities.
Cluster 12:	Solves simple word problems in the context of academic tasks, everyday tasks, or employment activities.
Cluster 13:	Organized data into tables, charts, and graphs in the context of academic tasks, everyday tasks, or employment activities.

Cluster 14: Interprets data which has been organized in the context of academic tasks.

Additionally, overall average daily attendance for the students enrolled in math during the sixty day implementation period was projected to exceed 69 percent as measured by daily classroom attendance figures for the five classes taught by the writer.

Measurement of Objectives

The objectives were measured by performance on the fall administration of the Standardized BST Practice Test and classroom attendance records.

Daily, weekly, and monthly records of individual and group progress, attendance, and activities were kept. Computer software for the IBM PC was used to accumulate data on individual students as work was progressively completed.

Cumulative records were used to conduct comparative analysis of progress in achievement and attendance by students enrolled in mathematics classes.

Chapter IV

SOLUTION STRATEGY

Discussion/Evaluation of Possible Solutions

The problem in this practicum was to assist at least 20 of the 32 students, (from an initial math enrollment of 50 students) who were deficient in the expectation for math performance, to achieve 70 percent minimum mastery on at least three of the five math problem solving indicator clusters on the school's standardized Basic Skills Practice Test. In addition, the writer sought to positively impact low student interest in the study of mathematics and decrease the unacceptably high degree of student absenteeism in mathematics classes to at most 30 percent.

The literature suggested a number of approaches that could be successfully applied in resolving or ameliorating the problem of low mathematical problem solving ability, interest in math activities, student attendance and math achievement.

According to Ediger (1984), the mathematics teacher needs to guide students to identify and solve practical problems in the societal area. The utilitarian problem solving areas for students to develop solutions are unit pricing of several brands of cereal, flour, and soap. Students need to ascertain which brand would be the best to buy, all other variables kept constant; keeping a checkbook

balanced accurately; computing the total cost of items ordered from a catalog or purchased from a local store; determining the amount of federal, state, and local tax due; and determining the potential amount of interest paid on installment plans. These represent actual situations in life with which problem solving is involved. Ediger suggests that calculators and computers can do the job quicker and students should be taught to utilize these manipulatives.

Furthermore, Ediger purports that simulations can provide role playing for students and suggests that the microcomputer is a worthwhile tool for use in the simulation arena. Computer Managed Instruction (CMI) can assist teachers in many ways, such as taking the drudgery out of checking papers; keeping results of test scores for students; assisting in selecting objectives for a student based on items missed in a testing situation; providing test results to teachers based on items analysis; and providing hard copies of actual tests to be utilized.

According to Glasser (1990) student boredom and subsequent lack of success in traditional "boss managed schools" (p. 39) both of which pose special problems for the "at-risk" student, can be successfully addressed, not through coercive practices employing the traditional ideas of longer school days or years, stiffer graduation requirements or more homework, but by helping students see the strong connection between what they are asked to do and

what they believe to be worth doing; coercion and traditional materials and approaches to classroom instruction fall short of this goal.

Glasser (1990) further asserts that a good teacher is one who can convince not half or three quarters but essentially all of his or her students to do quality work in school. In this method, the teacher becomes a "lead manager" (p.31); a lead teacher would start, for example, by discussing algebra, defining it, and explaining why it is taught and how students can use it in their lives. The lead-teacher would emphasize to the class that any student who really desires and makes an effort can learn algebra. After answering immediate questions from students, the teacher would explain that much of the work would be done in small cooperative groups in which students would help each other. The teacher would then assign at least one capable student to each cooperative group and would teach the student leaders how to model the problem solving techniques for the rest of the group. The teacher would emphasize that the purpose of the groups is to help them all to understand algebra, not just to get the problems done. Moreover, Glasser (p. 31) contends that there are four essential elements to lead-management:

1. The leader engages the workers in a discussion of the quality of the work to be done and the time needed to do it so that they have a chance to add their input.

2. The leader shows or models the job so that the worker who is to perform the job can see exactly what the manager expects.
3. The leader asks the worker to inspect or evaluate their own work for quality, with the understanding that the leader accepts that they know a great deal about how to produce high-quality work and will therefore listen to what they say.
4. The leader is a facilitator in that he shows the workers that he has done everything possible to provide them with the best tools and workplace as well as a noncoercive, nonadversarial atmosphere in which to do the job.

The essence of good managing, according to Glasser is a lot of caring and an equal share of hard work. "Acting, posturing, dramatizing, shouting, gesturing, and criticizing are styles a manager may choose as he or she attempts to add drama and excitement to what can easily become a boring process" (p. 38). Lead-managers often find creative approaches to the difficult problem of persuading people to do what they are reluctant to do or would otherwise not do.

Deblois (1989) reported that dropouts are the most glaring failure of schools. To keep at-risk students in school, he contends that educators must proceed on the belief that these students have the capacity to become more than minimally educated. School should be the primary place where this learning begins in earnest. Deblois further suggests that alternative schools can succeed if they are small and located in a separate building where teachers and students are able to develop their own identity.

Finally, Deblois suggests that computer-assisted instruction has the added benefit of helping to uncover learning problems, learning disabilities, and hidden learning talents. Technology assisted mastery learning, according to Deblois, lends itself very well also to peer tutoring by helping to create a cooperative learning environment. At the same time such computer-assisted learning is flexible and individualized enabling each student to progress at his or her own pace.

According to Pogrow (1990), if educators want to enhance learning of at-risk students, they should try to do it directly by using ordinary computer-assisted instruction (CAI); yet better results may come from using the Socratic approach. Pogrow developed the HOTS (higher order thinking) program that produces larger gains in basic skills than other remedial approaches. The HOTS program uses computers as one of four elements that collectively comprise the learning scenario. The four components of the HOTS program include 1) computers in a problem solving setting, 2) dramatic techniques, 3) Socratic conversations, and 4) thinking skill development.

With component one, since the software, usually games or recreational activities, is selected for motivation and not for its explicit goals, students learn content and thinking skills simultaneously.

With component two, learning by dramas is often used

with costumes, joke telling, etc., to engage students emotionally in the learning tasks. Through such activities the behavior of students is critically examined and often modified bearing out Vygotskey's (1986) finding that interaction about ideas in socially meaningful situations is critical to the internalization of those ideas.

The third component, the use of Socratic conversation, is based on Pogrow's premise that conversation between teacher and student is the heart of learning. The teacher must react to students' questions and answers in ways that maintain the ambiguities, probes, and clues that guide students to construct meaning on their own.

The fourth and final component of the HOTS program is the thinking skills curriculum. Questions are listed and teachers are trained to channel conversations in ways to develop critical thinking skills. The four important skills for this component are metacogniton, or the conscious application of strategies while solving problems; inference from context, or use of known clues to figure out unknown information; decontextualization, or the extraction of a generalization from one setting and the application of it in another setting; and information synthesis, or the identification, combination, and use of relevant information from two or more sources.

Summatively, Pogrow (1990) contends that computers can provide a vehicle for developing creative and sophisticated

curricula and pedagogical practices. Educators must recognize that a roundabout but sophisticated approach to using technology may improve the learning of at-risk students much more than direct but simplistic routes.

Suydam (1984) suggests that mathematics programs must take full advantage of the power of computers and calculators at all grade levels. The development and use of diverse imaginative materials should be a part of the curriculum. Computer-assisted instruction (CAI) can help students with drill practice, tutorial, simulations, and games. A gradual integration is suggested with a definite plan of attack. Careful evaluation and selection of software for materials taught are necessary for problem solving situations and strategies.

Mason, Burton, and Stacey (1984) indicate that problem solving (though but one phase of developing mathematical power) is best taught in small groups. Each group should determine what steps to pursue. Students can develop standards by which arguments can be considered (first convince yourself, then a friend, then an opponent) by problem solving thinking.

Burns and Klingstedt (1987, pp. 417-418) suggest that individual instruction with a new focus can foster academic excellence and might give what is needed for student improvement. Individuals who can think for themselves, solve problems, make decisions, and produce original ideas

is the excellence needed. This new focus is the interrelation of challenge (expecting and requiring uncommonly learned skills), functionalism (applying what is learned in daily living), high-order learning (learning, thinking in terms of solution), and originality (anticipating and predicting different results). This four part approach to high quality individualization is a step in the right direction to correct low achievement in learning.

Kantowski (1983) maintains that microcomputers are ideal tools for teaching problem-solving. CAI for mathematical problem-solving is successful because computers are interactive. Students can learn the problem-solving process rather than simply the application of an algorithm. The capability of computers to use time and space is advantageous because of the store strategies within each computer that can be followed with new problems that are encountered. Common underlying structures in a variety of problems is available. Finally, with computers, the opportunity for students to explore and solve a variety of routine and non-routine problems can be improved.

Throndyke and Summach (1982) propose that computers have untapped potential for enhancing student motivation as well as for stimulating effective learning. CAI involves the individual actively in the learning process at his own pace. CAI reduces learning time, improves student attitudes toward the use of computers, and gives a new dimension to

classroom teaching because of the many available simulations.

In the opinion of Good et al. (1990), the potential benefits of cooperative learning and work groups for enhancing motivation, which include increased enthusiasm, positive peer interaction and advanced mathematical thinking, warrant further trials of that format in the classroom in combination with development and utilization of more appropriate instructional materials.

Description of Solution Selected

On the basis of the preceding bibliographic research, the writer was convinced that the development and implementation of a program incorporating modern day advances in technology and computer-based instruction would constitute a reasonable approach to making practical application of the research-based ideas provided in the literature for enhancing and improving problem solving instruction and achievement for the at-risk population of students in this alternative school mathematics setting.

Educational innovations in the practicum, therefore, included non-coercive lead-management techniques as advocated by Glasser (1990), personalized learning experiences which are reported by Will (1989) to be helpful for at-risk students, and other strategies including the application of learning styles research, cooperative work

groups, and innovations for teaching higher-order problem-solving skills in mathematics.

The teacher involved students with alternative and non-traditional approaches to teaching and learning including technological innovations, computer-based instruction, manipulatives, and other non-traditional classroom approaches and procedures. Moreover, grouping and styles of learning were commonly addressed.

The students were asked to estimate results using rounded numbers, with or without units of measurement, in the context of academic tasks, or employment activities.

The students solved simple word problems in the context of academic tasks, everyday tasks, or employment activities. The students organized data into tables, chart, and graphs in the context of academic tasks, everyday tasks, or employment activities.

The students interpreted data which had been organized in the context of academic tasks, everyday tasks, or employment activities.

The solution strategy incorporated above all else the development and promotion of alternative non-traditional approaches to teaching and learning. Technological innovations, computer-based instruction, and collaborative and cooperative techniques for group thinking and problem-solving were central to classroom instruction. The following additional strategies were included:

a. Teacher and student computer literacy were developed.

b. Teacher and student exploration of new and innovative computer software was actively promoted.

c. Hands-on student use of the hardware were regularly provided. Instruction in and experience with hardware was regularly provided.

d. Computer software was correlated with textbook course work.

e. A library of multiple-use software was initiated.

f. Student work-group interest areas were developed.

g. Total school computer awareness was addressed.

The rationale for the solution selected was that students enrolled in this school had low interest in school and learning in general; therefore innovative techniques were seen as ways to involve students in the learning process and encourage them to attend school. If school could be made an exciting place with worthwhile classroom experiences incorporating a broad variety of motivation strategies, perhaps the students would attend school more regularly and become inspired to learn mathematics.

With computers, manipulatives, cooperative groups, and innovative questioning techniques in the mathematics classroom, the writer was convinced that students could be more effectively helped to master problem-solving skills, thinking skills, and overcome anxiety from poor academic achievement in mathematics.

Report of Action Taken

A summary of the action taken in implementing the plans and strategies designed to accomplish the goals and objectives of the practicum follows:

Month I

Week I

Student math skills were pre-tested using the school's standardized basic skills practice test. Learning preferences were assessed and documented using appropriate extractions from the learning styles literature (Dunn & Dunn, 1978; Kolb, 1976; Gregore, 1982; and Canfield, 1983).

A math aptitude and interest survey (see Appendix C) was administered by the writer to assess the initial level of student interest in mathematics.

Materials and alternative lessons were developed through the cooperative effort of teachers and students to accommodate the various learning modalities of the students.

Manipulatives for learning math were assembled; others were ordered; grant proposals were written in search of funding for materials (see Appendices D and E).

Week II

Flexible grouping was initiated as an approach to cooperative problem solving in the classroom. Students were allowed to form problem solving triads with the stipulation that triad membership could not remain fixed for more than two class sessions each week. Students were introduced to the computer and with the help of Local Area Network

Supervisor (LANS) each math class was scheduled for the computer lab for a minimum of two days each week.

Preliminary exercises in problem solving were conducted with the problem solving triads and use of the computer was illustrated with large and small group sessions. Cooperative classwork and peer assistance were modeled and stressed as the instructional method of choice for the entire practicum period.

Week III

Classroom sessions incorporated large group attention to general problem-solving deficiencies assessed by the math pre-test. Students practiced in their cooperative triads and in individual practice sessions.

Proper use of the manipulatives and calculators on hand were demonstrated and modeled to peer leaders who duplicated this effort in both the triads and with individual students. Work in the computer lab was augmented by commercially acquired software and by software on loan from colleagues at other sites.

Additional lessons and alternative activities were developed to address variance in learning style. Calculators were now in regular use in all classes.

New students were assigned peer tutors to help assess and provide for their needs. Group and cooperative learning was stressed as the class goal and primary procedure for learning mathematics.

Problem solving in the triads continued. The teacher monitored and facilitated group work. Socratic questioning techniques were used to stimulate and direct thinking and problem solving using the pre-assessment errors. Thinking about thinking was encouraged. Individual remediation and enrichment was provided.

Week IV

Progress checks were made during this week. Six new students were assessed and mainstreamed into the program through the help of assigned peer assistants. Two motivational techniques were introduced to boost attendance and student self esteem. The first was an attendance honor roll through which at the end of every three weeks students with 85 to 100 percent attendance were honored and presented a certificate, small gift, a privilege, etc. The second was a "star student bulletin board" on which was posted, at the end of each three week period, the names of the three students with highest academic averages in mathematics.

Month II

Week I

During this week four students were withdrawn from the school. Two new students were assessed and brought into the program.

The students in general were now more acclimated to the classroom routines. Tuesdays and Thursdays were formally established as regular computer lab days. Students were

voluntarily acquiring diskettes to save their computer activities and to copy educational and recreational games.

Elementary computer programs in beginners all-purpose symbolic instruction code were being written and used by nearly half of the students to perform activities which they discovered were repetitious and well-suited for the computer.

Week II

This was an exciting week for the students-the third week since instituting the attendance honor roll and star student(s) bulletin. Seventeen students were honored for having achieved 80 percent or better average daily attendance. The three star students were elated to see their names posted prominently on the front classroom wall for all to see. This validation of their personal worth and achievement would be boasted and bragged about over the next several weeks. The computer was used to generate certificates for all students honored. The certificates were laminated and presented publicly to students with a great deal of fanfare.

Week III

It became necessary during this week to provide additional discussion and modeling on the value and operation of cooperative groups. Some group members were not participating, especially new enrollees. In other cases a strong team member simply worked the problems and passed the work or answers around, then complained that it was

unfair to do all the work and have others share the credit. Discussions were breaking down and off-task behavior was increasing.

It was decided by the teacher that unless any randomly selected group member called upon to discuss a solution or rationale could make an acceptable response, credit for that problem would be withheld from all members until the group could make further deliberations and clarify the matter under examination. The appropriateness of this strategy was validated in subsequent weeks by the increased cooperation observed among group members and by the increased attention shown by most students on group as opposed to individual success.

Week IV

The major academic emphasis during this week was toward clarifying any problems or questions related to the five problem solving skill clusters on which most of the instruction and student activities had been focused over the prior seven weeks.

Large group discussion sessions allowed opportunity for reflection on what had been attempted so far with regard to working in groups and making use of computer technology and other manipulatives in learning.

Students shared their initial apprehension and uneasiness with these methods as well as the enthusiasm acquired for these procedures as the course progressed. One student aptly responded, "You seem to be teaching us that

when it comes to learning we're all sort of our brothers' keepers." Another remark which the writer found apropos was, "It's fun, but it's still a lot of hard work."--A truism, indeed, for all learning.

Month III

Week I

The first two days of this week were used to administer the basic skills practice test and to tabulate preliminary attendance data.

Test results were shared and discussed with students. Thirty-one students, an average of six per class, were honored for 80 percent minimum attendance. Two of the initial star students were honored for the second time. The addition of one new star student was celebrated.

Plans and additional activities were developed for the remaining week of the practicum implementation period.

Week II

Efforts were made during this week, in response to concern expressed by students, to make greater accommodation for the learner who needed greater mobility and who desired intake and a less structured environment.

The project administrator (principal) ruled out the possibility of food or drink except in the non-teaching areas of the building. Activities employing team competition role-playing and other simulations were introduced for practicing skills and reinforcing developed concepts. Public music was introduced and permitted

regularly, but was controlled by the teacher. No earphones or private music was allowed. Students and groups who so desired were allowed to sit or lie on the carpet or work in designated areas outside the classroom.

Week III

Students continued their work in cooperative triads and in the computer lab. Enrichment computer activities and games were used for students who had achieved mastery on the major skill clusters developed during the previous weeks.

Independent contracts were also used in providing opportunities for students to extend and expand their working knowledge of major skills and concepts.

Week IV

This final three day week was used by the students to wrap up all incomplete activities on an individual basis. Those not yet having completed the math post-test were tested. Some students assisted in the preparation of additional activities suggested by their peers for skill development during subsequent instructional periods.

Post assessments for math interest were concluded. The math interest survey (Appendix C) was used as the post-assessment instrument for comparing the student's present interest in and attitude regarding the study of math with the corresponding interest in math assessed upon initiation of the practicum.

Chapter V

RESULTS, DISCUSSION AND RECOMMENDATIONS

Results

The goal of this practicum was to assist at least 20 of the 32 students, from an initial math enrollment of 50 students who were deficient in the expectation for math performance, to achieve 70 percent minimum mastery on at least three of the five math problem solving indicators on the school's standardized Basic Skills Practice Test. Since this would translate roughly into a 75 percent success level for the initial math enrollment (actually 76 percent - 36 out of 50), this 75 percent success level was adopted for use in the practicum whether math enrollment should fluctuate or remain stable during practicum implementation.

In addition, overall average daily class attendance for the students enrolled in mathematics during the 60 day practicum implementation was projected to exceed 69 percent.

Through the use of computers, manipulatives, cooperative groups and Socratic questioning in the mathematics classroom, and with lessons and activities developed to address a variety of learning preferences, the writer thought that students could be greatly assisted in mastering the desired problem-solving and thinking skills and in overcoming the problems of limited interest and poor attendance.

The pre- and post-test results of the performance of all students on the five problem solving indicators of the basic skills practice test are indicated in Table 6. Seventy percent minimum mastery is indicated with a plus sign, non-mastery with a minus. From Table 6 it can be seen that the academic objective of the practicum was successfully met. It was projected that the practicum would result in 38 of the 50 initially enrolled students demonstrating 70 percent minimum mastery on at least three of the five problem solving clusters (10-14). The post-test results indicated that 41 of the 48 students enrolled at the conclusion of the practicum (the net change in student enrollment during the practicum was a decrease of two students) actually attained such success.

Moreover, while pre-test results indicated that none of the five clusters was successfully mastered at the 70 percent level by seven of every ten of the enrollees; post-test results indicated that only one cluster, Cluster 11, was not successfully mastered by seven of every ten enrollees.

The success on this objective must be attributed not only to the strategies used in this practicum, but also to the exceptional cooperation and hard work of the students.

Table 6

Comprehensive Basic Skills Practice Test Profile-B

Problem Solving

Student	BST indicators 10 Pre/post tests		11 Pre/post tests		12 Pre/post tests		13 Pre/post tests		14 Pre/post tests	
A	+	+	-	-	+	+	-	+	-	+
B	-	+	-	-	+	+	+	+	+	+
C	-	+	-	-	+	+	+	+	+	+
D	-	+	-	-	-	-	-	+	-	+
E	-	+	-	-	-	+	-	+	-	+
F	-	+	-	+	+	+	+	+	+	+
G	+	+	+	+	+	+	-	+	-	+
H	+	+	+	+	+	+	-	+	+	+
I	-	+	-	-	-	-	-	+	-	+
J	+	+	-	-	+	+	+	+	-	+
K	-	+	-	-	+	+	-	+	+	+
L	-	+	+	-	+	+	+	+	-	+
M	-	+	-	-	-	-	-	-	-	-
N	+	+	-	-	-	-	-	+	+	+
O	-	-	-	-	-	-	+	+	-	+
P	-	+	-	-	+	+	+	+	+	+
Q	-	+	-	-	+	+	-	+	-	-
R	-	+	-	-	-	+	-	+	-	+
S	-	+	-	-	+	+	+	+	+	+
T	+	+	-	-	+	+	+	+	+	+
U	-	+	+	+	-	+	+	+	+	+
V	-	-	-	-	-	-	-	-	-	-
W	-	+	+	+	-	+	+	+	+	+
X	-	-	-	-	-	-	-	-	-	-
Y	-	+	-	-	-	+	-	+	-	+
Z	-	-	-	-	-	-	-	-	-	-
A-1	+	-	+	+	+	+	+	+	-	+
B-1	-	-	-	-	-	+	-	+	-	+
C-1	-	+	+	-	+	+	+	+	+	+
D-1	+	+	-	-	-	-	-	+	+	+
E-1	-	+	-	-	-	+	-	+	-	-
F-1	-	-	-	-	-	-	-	-	-	-
G-1	-	+	-	-	-	-	-	+	-	+
H-1	-	+	-	-	-	+	-	+	-	-
I-1	-	+	-	-	-	+	-	-	-	+
J-1	-	+	+	+	-	+	+	+	-	+
K-1	-	+	+	+	+	+	+	+	+	+
L-1	-	-	-	-	-	-	-	-	-	-
M-1	-	+	-	-	-	+	-	+	-	-
N-1	+	+	-	-	-	+	+	+	-	+
O-1	-	+	-	-	+	+	+	+	+	-
P-1	-	+	-	-	+	+	-	-	+	+
Q-1	+	+	-	-	-	-	+	+	+	+
R-1	-	+	-	-	-	-	+	+	+	+
S-1	-	+	-	-	-	+	-	-	-	+
T-1	-	+	-	-	-	+	-	+	-	-
U-1	-	+	-	-	-	+	-	-	-	+
V-1	-	+	-	-	-	+	-	-	-	+
W-1	+		+		+		-		-	
X-1	-		-		-		-		-	
Total passing (>=70%)	11	40	10	8	19	34	19	37	18	36
Total failing (<70%)	39	8	40	40	31	14	31	11	32	12

The bar chart in Figure 1 compares the number of students scoring at or above 70 percent on each of the problem-solving clusters before and after practicum implementation. Although a decline in student performance from pre- and post-tests is indicated on cluster 11, all other clusters show increases in student performance.

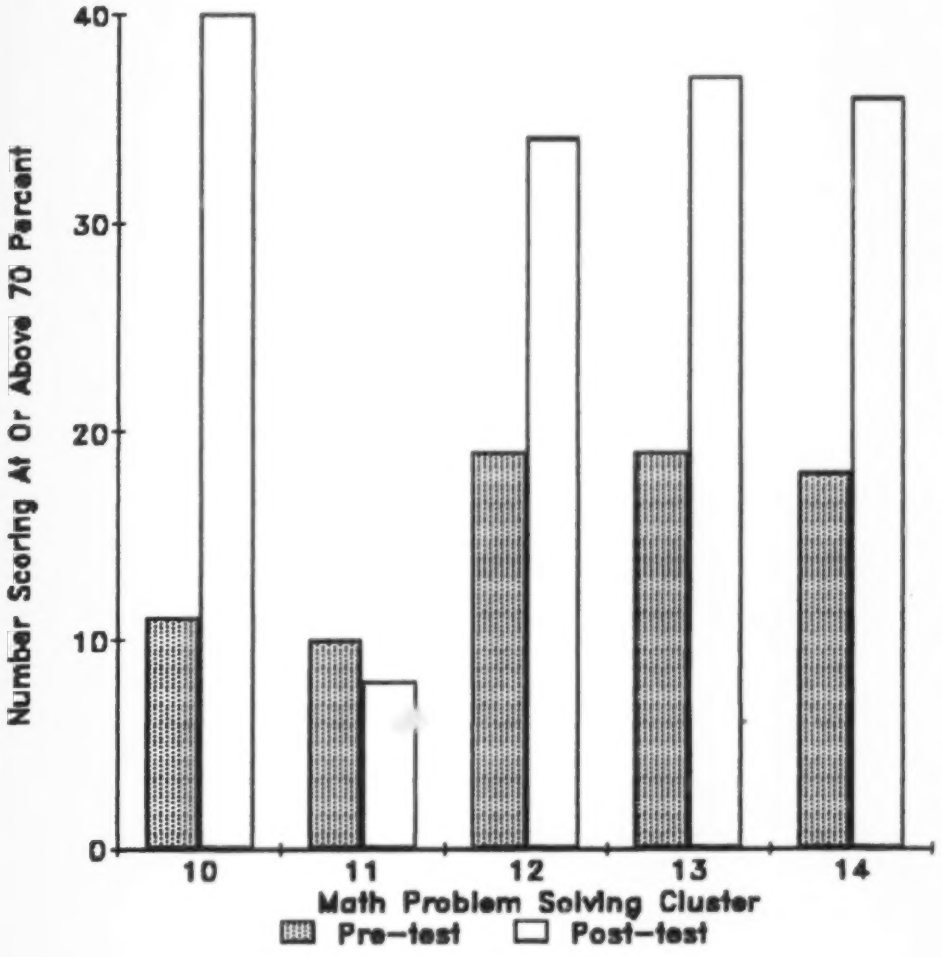

Figure 1

Comparison of pre- and post-test performance by students on selected math clusters of the 1990 administration of the school's standardized basic skills test

The writer envisions at least two plausible reasons for the lack of improvement by students on the cluster 11 skills which involved the ability to select appropriate operations for problem situations and the reverse.

Students, first of all, had evidently encountered less prior experience in identifying the appropriateness of an operation than with the other skills addressed during the practicum. An inordinate amount of time had to be spent and countless examples had to be explored to simply explain and illustrate the value of this skill in effectively solving problems. The concept seemed foreign to most students and from their viewpoint its importance was being exaggerated by the teacher before, during and subsequent to extensive consideration of the idea over several class sessions. The instructional stimulation provided by the teacher was evidently insufficient to initialize the students' personal and internal motivation to successfully process and assimilate this new information.

A second possible reason for the lack of success on cluster 11 has to do with the very nature of the cluster 11 skill. In the writer's opinion, the skill of identifying the appropriateness of an operation for a problem situation involves application of one or more of the three higher level thinking skills of the Bloom Taxonomy - analysis synthesis, and evaluation. The inappropriate reasons given by students for explaining why a given operation was selected highlights both the need for and the absence of

higher level analysis as a part of the students' routine decision making apparatus. One student, for example, explained the criteria he reportedly used over the years for choosing an operation for a given problem situation in the following way and was supported by other students in the class: "If the problem has a lot of numbers in it, I just add. If it has two real large numbers, I subtract. If the problem contains one large number and one small number, I divide and if none of these seem to fit, I multiply."

Interestingly enough, the use of such a totally inappropriate and invalid set of criteria would probably lead to the selection of a correct operation at least some of the time. Never, though, would it lead to a correct operation for the correct reasons and on the basis of a thorough examination and analysis of the problem situation which is the very essence of geniune problem solving. The lack of success on cluster 11 skills by the targeted students, for whatever reasons, seems to pinpoint a need to address this skill and the erroneous criteria developed by students over the years for selecting a problem-solving operation during future instructional periods. Despite the lack of improvement by students on the cluster 11 skills, improvement in each of the other academic skill clusters was documented and the overall academic objective of the practicum was satisfactorily met.

From table 7, in which initial and terminal attendance data for the enrolled students were compared by class

period, it can be seen that the attendance objective was similarly met. It was projected that average daily attendance initially measured at 50 percent would be increased to a minimum of 70 percent.

From the table it can be seen that the overall average daily attendance for the five math classes after practicum implementation was exactly 70 percent (67 percent for first period; 76 percent for second; 66 percent for fourth; 69 percent for fifth; and 70 percent for sixth.)

Table 7

Sixty Day Attendance Data

Class period	Number students on roll	Days x students for perfect attendance	Recorded absences for the period	Percent absent	Percent average daily attendance (ADA)
1st	10	600	200	33	67
2nd	10	600	146	24	76
3rd	-	-	-	-	-
4th	10	600	202	34	66
5th	10	600	184	31	69
6th	8	480	142	30	70
Total	48	2880	874	30	70

The bar chart in Figure 2 shows increases in attendance from the initiation of the practicum to its conclusion and shows an overall increase in attendance from approximately 50 percent prior to practicum implementation to 70 percent after implementation.

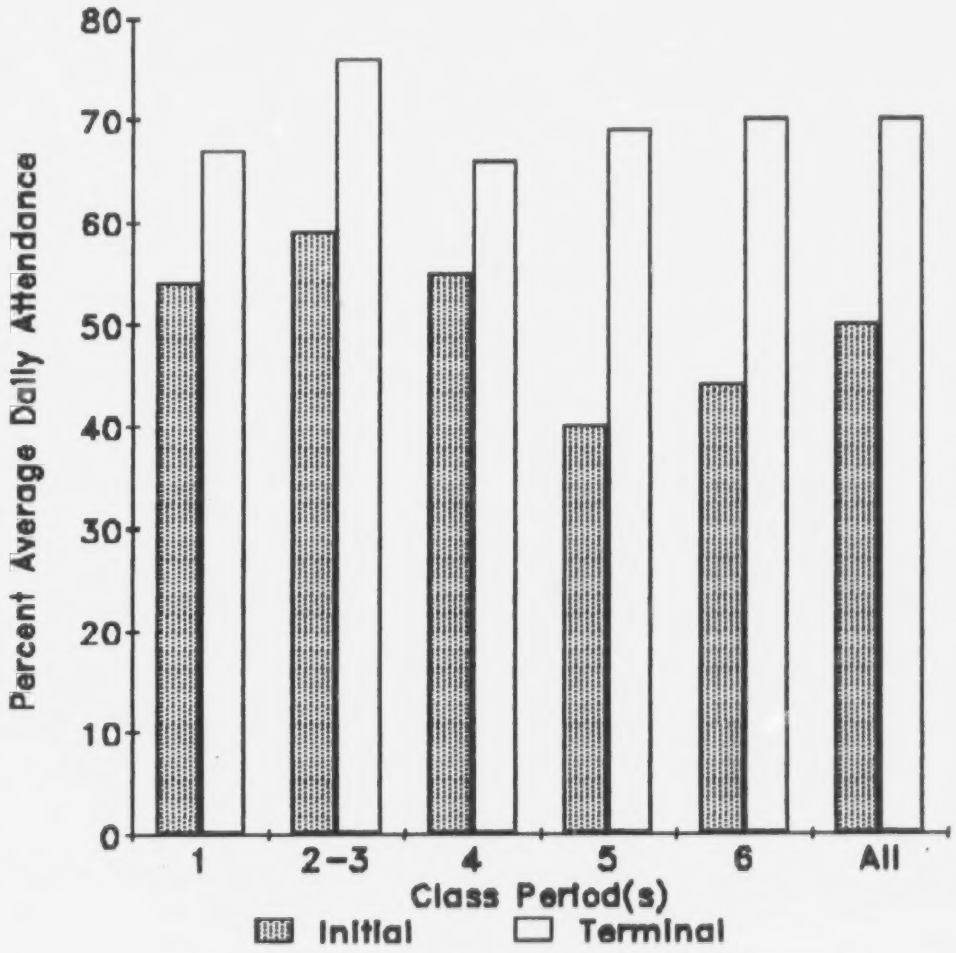

Figure 2
Comparison of initial and terminal attendance data for students over the sixty day practicum implementation period

No major differences were noted when comparing the student's pre- and post-test math interest survey responses (See appendix C). Moreover very little in the way of strong feelings or changes in attitudes could be determined from the nature of the responses. The only items for which at least 35 of the 50 targeted students responded with checks in the "strongly agree" column on both administrations of the interest survey were emotionally neutral items such as "Math is useful", "Math is important", and "Math is difficult". Likewise, strongly worded positively or negatively phrased items such as "I love Math", "I hate Math", "Math is great", and "Math is the pits" were responded to routinely with checks in the "disagree" column of the survey (in nine out of ten responses on the pre-test and eight of ten on the post-test).

Eight of every ten students on both adminstrations of the survey indicated that Math was a "difficult" subject. Twenty-four or nearly half of the fifty initial students "agreed" that they have "always enjoyed math" on the survey pre-test; Twenty-four or exactly half of the forty-eight terminal students "agreed" with that item on the survey post-test.

Similarly, twenty-six of the fifty initial students "agreed" that they "never really liked math" on the survey pre-test while twenty-four of the forty eight "agreed" with this item on the post-test. The instrument used to measure interest in math may well need refinement.

Discussion

The improvements observed while implementing this practicum, despite the fact that no major differences were noted in the pre- and post- math interest survey results (Appendix C), have strongly impacted the writer's perception of teaching and learning. Although the practicum implementation period of three months may not have provided sufficient time to impact such deeply ingrained factors as attitude and interest it was quite adequate in determining, in the writers opinion, that the value of technology and cooperation in the classroom today might be enormously underrated. Not only do computers provide for a high level of individualization which is desired by teachers; but they do so with a flair which is intriguing and captivating to low achievers, high achievers, and seemingly all students in between. The untapped potential of computers for enhancing student motivation as proposed by Throndyke and Summach (1982) must be harnessed and utilized in an effort to offset the debilitating effects on the at-risk student of declining interest in school work, disenchantment and boredom with learning, and low class attendance. Not only can computers be used to help students with drill and practice; more importantly, according to Kantowski (1983), they are ideal tools for teaching problem-solving. The writer is convinced that the interactive nature of the computer gives CAI an unparalleled advantage in the teaching of mathematical

problem-solving. With the computer, the students targeted in this practicum were able to examine, practice, and solve such a vast quantity and variety of routine and non-routine problems as would not have been possible in any other way.

The greatest drawback to the use of technology and computers experienced by the writer was the paucity of diverse, imaginative materials and software which according to Suydam (1984) should be an integral part of the instructional curriculum. Time constraints and limited resources obviously mitigate against the individual teacher providing for such needed materials. This practicum effort has provided the writer an opportunity to begin a gradual development and selection of these essential components of an effective problem-solving program at this work site.

Probably the most important lessons learned about classroom cooperation during the implementation of this practicum are that (a) cooperation works and (b) cooperative learning is a valuable teaching strategy that more than repays teachers for the investment of time and effort that must be made to use it effectively. Both academic and social benefits accrue to the involved students.

Though the writer as well as the students targeted in this practicum were initially apprehensive and uncertain about the merits of this strategy, patient application of the research supporting this approach to teaching and learning soon proved advantageous to all concerned.

Students soon came to realize that cooperation rather than competition could improve both their attitudes toward school and their self-esteem as they received help and shared their own expertise for the benefit of the total group and their individual neighbors. The social and interpersonal skills of the drop-out prone students served at the writer's site were dramatically improved. Genuine support became the common reaction of the students toward a peer in need of assistance. "We're in this together" became a sort of rallying theme. Such interpersonal skills, according to Johnson et al. (1988), may be the set of skills most important to one's employability, productivity, and career success.

The combination of technology, manipulatives, and cooperative strategies served well to address a variety of student learning preferences. With the teacher and students no longer lecture and seat-work bound, the classroom became a hub of varying activities and many students who never participated became active participants. The writer is well pleased with the solution selected in this practicum for addressing the student's low attendance, interest, and performance in mathematics. The successful outcomes are thought to be directly related to the hard work of the students and the impact of technology and cooperative classroom methods on improving interest and math achievement.

Recommendations

Two recommendations seem apropos. With regard to the use of technology for improving instruction the caution already mentioned bears repeating. The extent to which success can be expected in the use of technology and computers in the classroom is a function of the extent to which the instructional curriculum supports diverse and imaginative materials and software. Consideration of this factor should be seriously anticipated and examined before embarking upon the implementation of a technology-based instructional program.

The second recommendation, like the first, is also a caution but in connection with classroom cooperation. Teachers need regular released-time training and continued follow-up support in order to acquire and utilize the complex strategy of cooperative learning in the regular classroom. An excellent resource located by the writer for meeting this need is a five volume video taped series developed in consultation with Robert Slavin, Roger Johnson, David Johnson, and Brit Vasquez and sponsored in 1990 by the Association for Supervision and Curriculum Development. The series addresses the need for cooperation in the work-place, the basic elements of successful program, the skills teachers and students need to successfully operate in a cooperatively structured classroom, three generic models developed by Slavin and a complete lesson taught with cooperative learning. Because much of the training and

preparation received by the writer for this practicum was self-developed and independently acquired, it proved to be extremely costly and time-consuming. The successful practicum outcomes, however, could not have been more rewarding.

Dissemination

The successful outcomes of this practicum have been shared with the administrative directors at the local school setting and with the writer's immediate colleagues. The achievement is celebrated by the entire school family. The writer anticipates assisting local teachers in an interdisciplinary employment of the solution strategies across subject matter areas. Preliminary plans have been made to offer instructional sessions to teachers at the local site in both the use of technology in the classroom and cooperative learning and teaching strategies.

The sharing of these strategies in the five other alternative school settings is also under consideration. The writer looks forward to refining these strategies and utilizing them with even greater success in addressing the needs of deserving populations of alternative high school math students.

References

Alderman, M. K. (1990). Motivation for at-risk students. Educational Leadership, 48(1), 27-30.

Atlanta Public Schools. (1989, June). Alternative schools program evaluation. Rep. 7(23) Atlanta: Division of Curriculum and Research Services.

Brody, L. & Brody, S. (1984). Classmate [Computer program]. Rancho Palos Verdes, CA: Davidson & Associates.

Burns, R. & Klingstedt, J.L. (1987). Excellence through high-quality individualization. Clearing House, 6(39), 417-418.

Canfield, A. A. (1983). Canfield learning styles inventory, form S-A. Ann Arbor, MI: Humanics Media

Deblois, R. (1989). Keep at-risk students in school: Toward a curriculum for potential dropouts. NASSP Bulletin, 7, 6-12.

Dunn, K. & Dunn, R. (1978). Teaching students through their individual learning styles. Reston, VA: Reston Publishing Company.

Ediger, M. (1984). Philosophy of Microcomputer use in mathematics curriculum. Washington, DC: U.S. Department of Education: National Institute of Education.

Georgia Department of Education. (1986, July). Georgia basic skills tests: objectives and assessment characteristics. Atlanta: Standards and Assessment Division.

Glasser, W. (1990a). The quality school. Phi Delta Kappan, 34(9), 425-436.

Glasser, W. (1990). The quality School. New York: Harper and Row

Good, T., Reys, B., Douglas, & Mulryan, C. (1989-90). Using work-groups in mathematics instruction. Educational Leadership, 67(4), 56-62.

Gregore, A. F. (1979). Learning/teaching styles: potent forces behind them. Educational Leadership, 36(4), 234-36.

Johnson, D. W., Johnson, R., & Holvbec, E. (1988). Cooperation in the classroom. Edina, MN: Interaction Book Company.

Kantowski, M. G. (1983). The microcomputer and problem solving. Mathematics Research, 21(7), 20-58.

Kolb, D. A. (1976). Learning styles inventory. Boston, MA: McBer and Company.

Lee, D. & Berman, L. (1987). Teenager parents talk about schools: meaning for the curriculum. Educational Forum, 16, 15-19.

Mann, D. (1986). Dropout-prevention-getting serious about programs that work. NASSP Bulletin, 59, 66-73.

Mason, J., Burton, L. & Stacey, K. (1982). Thinking mathematically. London: Addison-Wesley Publishing.

Perrin, J. (1990). The learning styles project for potential dropouts. Educational Leadership, 48(2), 23-24.

Pogrow, S. (1990). A Socratic approach to using computers with at-risk students. Educational Leadership, 47(5), 61-66.

Schoenfeld, A. H. (1989). Teaching mathematics thinking and problem solving. The Thinking Curriculum: Current Cognitive Research. Virginia: Association for Supervision and Curriculum Development.

Steen, L. A. (1989). Teaching mathematics for tomorrow's world. Educational Leadership, 47(1), 18-22.

Suydam, M. (1984). What research says: microcomputers and mathematics instruction. School Science and Mathematics, 84(4), 337-343.

Thorndyke, G. G. & Summach, R. D. (1982). CAI and the microcomputer. Education Canada: The National Magazine About Education, 22(4), 4-7.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological process. Cambridge, MA: Harvard University Press.

Will, M. (1989). Educating students with learning problems: a shared responsibility. Virginia Journal of Education, 82(9), 6-12.

Willoughby, S. S. (1989). Mathematics. Educational Leadership, 47(1), 87-90.

APPENDICES

APPENDIX A

STUDENT QUESTIONNAIRE

Survey Questionnaire

Students

Please write your anonymous response to each of the following questions. Thank you for your assistance with this survey.

Check those which apply:

You live with two parents_____
Guardian_____relationship_____
Mother_____Father_____

Circle one: Male/Female Age_____

Current Grade_____ Reason at Academy: Discipline_____
Attendance_____
Request_____
Referral_____
Other_____

Favorite Subject:_____

Least Favorite Subject:_____

Goal after graduation:_____

Grades last reporting:
Period
1_____
2_____
3_____
4_____
5_____
6_____

Greatest concern about school:

_____
_____

APPENDIX B

TEACHER QUESTIONNAIRE

Survey Questionnaire

Teachers

Please indicate your response to the questions listed below. Your responses will remain anonymous. Thank you for your assistance with this information.

Circle one: Male/Female

1. Years of experience _____

2. Years in present setting _____

3. Years at previous settings _____

4. Discipline area _____

5. What do you feel is needed to promote learning in this setting? _____
_____.

6. What do you feel is needed to promote inspired teaching in this setting? _____
_____.

7. If there were $500,000 available to spend on improvements, how would use the money?

First Choice_____

Second Choice_____

Third Choice_____

8. What is your greatest concern about teaching "at risk" students?_____

9. What is the average attendance in each of your classes?

Period		Period	
1	_____	4	_____
2	_____	5	_____
3	_____	6	_____

10. Express any comments you have in regard to teaching in this setting.

_____
_____

APPENDIX C

STUDENT MATH INTEREST SURVEY

Survey - Math and Me

For each item check the response that most nearly reflects your true feelings:

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	Math is a great subject.				
2.	I love math.				
3.	Math is the pits.				
4.	I hate math.				
5.	Math is a difficult subject.				
6.	Math is an easy subject.				
7.	Math is an important subject.				
8.	A lot of math is useless.				
9.	Math is boring.				
10.	Math is interesting.				
11.	I just can't do math.				
12.	Math is challenging.				
13.	Math is fun.				
14.	Math is a useful subject.				
15.	I could do without math.				
16.	Without math life would be great.				
17.	Without math life would be almost impossible.				
18.	Math teachers are sharp.				
19.	Math teachers are stupid.				
20.	I enjoy doing math.				
21.	I wish I didn't have to take math.				
22.	I'm glad I have to take math.				
23.	Math is one of my best subjects.				

Survey - Math and Me (cont'd)

For each item check the response that most nearly reflects your true feelings:

	Strongly Agree	Agree	Disagree	Strongly Disagree
24. Math is one of my worst subjects.	_____	_____	_____	_____
25. Most math problems make a lot of sense.	_____	_____	_____	_____
26. Most math problems make no sense at all.	_____	_____	_____	_____
27. I've always enjoyed math.	_____	_____	_____	_____
28. I've never really liked math.	_____	_____	_____	_____
29. Math was hard for my parents.	_____	_____	_____	_____
30. Math was easy for my parents.	_____	_____	_____	_____
31. All people need math.	_____	_____	_____	_____
32. Most people can do without math	_____	_____	_____	_____
33. I work hard at learning math.	_____	_____	_____	_____
34. I'll be glad when I'm finished with math.	_____	_____	_____	_____
35. Math is neat.	_____	_____	_____	_____
36. Math is a pain.	_____	_____	_____	_____
37. Math makes my day.	_____	_____	_____	_____
38. Math gives me a headache.	_____	_____	_____	_____
39. I think most people like math.	_____	_____	_____	_____
40. I think most people dislike math.	_____	_____	_____	_____
41. I plan to take all the math I can.	_____	_____	_____	_____
42. I plan to finish math as soon as I can.	_____	_____	_____	_____

Survey - Math and Me (cont'd)

For each item check the response that most nearly reflects your true feelings:

	Strongly Agree	Agree	Disagree	Strongly Disagree
43. Learning math makes you a better person.	_____	_____	_____	_____
44. Studying math is a waste of time.	_____	_____	_____	_____
45. Math is a beautiful subject.	_____	_____	_____	_____
46. Math is kinky.	_____	_____	_____	_____
47. I'm getting better at math.	_____	_____	_____	_____
48. Math stinks.	_____	_____	_____	_____
49. Only nerds like math.	_____	_____	_____	_____
50. Math makes the world go round.	_____	_____	_____	_____

APPENDIX D

SOUTHERN BELL PROPOSAL RESPONSE

Southern Bell

Pamela Pryor Fuller
Director-Corporate and External Affairs
Atlanta

Suite 300
133 Carnegie Way
Atlanta, Georgia 30303
404 653-6300
Fax: 404 688-1530

October 22, 1990

Mr. Martin Stuckey
Principal
Central Academy
1080 Euclid Ave., NE
Atlanta, GA 30337

Dear Mr. Stuckey:

Thank you for your interest in Southern Bell's GRANTS FOR TEACHERS program and for the grant application which you submitted for Woodrow Brickle II.

Due to budgetary considerations and time constraints, participation in the grants program for 1990 was limited to only six Atlanta Public Schools System schools and although your proposal has merit, we are unable to accept it for consideration at this time.

We wish Mr. Brickle every success in his efforts to improve the Math skills of your students, and hopefully we can expand the GRANTS FOR TEACHERS Program to include more schools sometime in the future.

Sincerely,

Pamela Pryor Fuller

PPF/dm

Enclosure

A BELLSOUTH Company

APPENDIX E

APPLE CORPS PROPOSAL RESPONSE

GRANTS TO TEACHERS

December 12, 1990

Woodrow Brickle II
Central Academy

Dear Mr. Brickle,

Thank you for your interest, time and effort in applying for a Grant for Excellence in Teaching.

Your grant application was reviewed by a panel of jurors blind of your name and school. The jurors ranked the applications by consensus and selected, based on their rank, those applications that should be awarded within funds available.

We are delighted that your proposal was selected to be funded by the jurors. Enclosed are your application and any comments made by the jurors.

It is with respect for you as a teacher that we award you your grant of $ 250. As we are held accountable by our donors for the distribution of the grants, so you are held accountable for the use of your grant.

Please keep a log of your expenses and your receipts. We ask you to turn these in with your appraisal form which we will mail to you in May. Any unused funds need to be returned to APPLE Corps.

I would like to visit as many grant projects as possible during the year. Please let me know when it would be appropriate to visit your classroom. The number at APPLE Corps is 522-4662. Thank you.

Good Luck!

Sincerely,

Nancy Hamilton

Nancy Hamilton
Program Director

Please note: All equipment purchased by a teacher with grant money belongs to that teacher for use in any Atlanta Public School. Should the teacher leave APS, the equipment remains in the school where the teacher last taught.

BEST COPY AVAILABLE